

§ 53.65

40 CFR Ch. I (7–1–12 Edition)

EQUATION 36

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}}$$

where:

i = replicate number.

(ii) With a number counting device as a detector:

(A) Install the particle size fractionator into one of the legs of the divided flow apparatus.

(B) Quantify and record the aerosol number concentration of the primary particles passing through the fractionator as $C_{cand(i)}$.

(C) Divert the flow from the leg containing the candidate fractionator to the bypass leg. Allow sufficient time for the aerosol concentration to stabilize.

(D) Quantify and record the aerosol number concentration of the primary particles passing through the bypass leg as $C_{total(i)}$.

(iii) Calculate and record sampling effectiveness of the candidate sampler as:

EQUATION 37

$$E_{(i)} = \frac{C_{cand(i)}}{C_{total(i)}} \times 100\%$$

where:

i = replicate number.

(6) Repeat step in paragraph (g)(5) of this section, as appropriate, to obtain a minimum of three replicate measurements of sampling effectiveness.

(7) *Calculate the mean and coefficient of variation for replicate measurements of effectiveness.* (i) Calculate and record the mean sampling effectiveness of the candidate sampler as:

EQUATION 38

$$\bar{E} = \frac{\sum_{i=1}^n E_{(i)}}{n}$$

where:

i = replicate number.

(ii)(A) Calculate and record the coefficient of variation for the replicate sampling effectiveness measurements of the candidate sampler as:

EQUATION 39

$$CV_E = \frac{\sqrt{\sum_{i=1}^n E_{(i)}^2 - \frac{1}{n} \left(\sum_{i=1}^n E_{(i)} \right)^2}}{n-1} \times \frac{1}{\bar{E}} \times 100\%$$

where:

i = replicate number; and

n = number of replicates.

(B) If the coefficient of variation is not less than 10 percent, then the test run must be repeated (steps in paragraphs (g)(1) through (g)(7) of this section).

(8) Repeat steps in paragraphs (g)(1) through (g)(7) of this section for each particle size specified in table F-2 of this subpart.

(h) *Calculations—(1) Treatment of multiplets.* For all measurements made by fluorometric analysis, data shall be corrected for the presence of multiplets as described in § 53.62(f)(1). Data collected using a real-time device (as described in paragraph (c)(3)(ii)) of this section will not require multiplet correction.

(2) *Cutpoint determination.* For each wind speed determine the sampler Dp_{50} cutpoint defined as the aerodynamic particle size corresponding to 50 percent effectiveness from the multiplet corrected smooth curve.

(3) *Graphical analysis and numerical integration with ambient distributions.* Follow the steps outlined in § 53.62 (e)(3) through (e)(4) to calculate the estimated concentration measurement ratio between the candidate sampler and a reference method sampler.

(i) *Test evaluation.* The candidate method passes the static fractionator test if the values of R_c and Dp_{50} for each distribution meets the specifications in table F-1 of this subpart.

[62 FR 38814, July 18, 1997; 63 FR 7714, Feb. 17, 1998]

§ 53.65 Test procedure: Loading test.

(a) *Overview.* (1) The loading tests are designed to quantify any appreciable

changes in a candidate method sampler's performance as a function of coarse aerosol collection. The candidate sampler is exposed to a mass of coarse aerosol equivalent to sampling a mass concentration of $150 \mu\text{g}/\text{m}^3$ over the time period that the manufacturer has specified between periodic cleaning. After loading, the candidate sampler is then evaluated by performing the test in § 53.62 (full wind tunnel test), § 53.63 (wind tunnel inlet aspiration test), or § 53.64 (static fractionator test). If the acceptance criteria are met for this evaluation test, then the candidate sampler is approved for multi-day sampling with the periodic maintenance schedule as specified by the candidate method. For example, if the candidate sampler passes the reevaluation tests following loading with an aerosol mass equivalent to sampling a $150 \mu\text{g}/\text{m}^3$ aerosol continuously for 7 days, then the sampler is approved for 7 day field operation before cleaning is required.

(2) [Reserved]

(b) *Technical definition.* Effectiveness after loading is the ratio (expressed as a percentage) of the mass concentration of particles of a given size reaching the sampler filter to the mass concentration of particles of the same size approaching the sampler.

(c) *Facilities and equipment required—*

(1) *Particle delivery system.* The particle delivery system shall consist of a static chamber or a low velocity wind tunnel having a sufficiently large cross-sectional area such that the test sampler, or portion thereof, may be installed in the test section. At a minimum, the system must have a sufficiently large cross section to house the candidate sampler inlet as well as a collocated isokinetic nozzle for measuring total aerosol concentration. The mean velocity in the test section of the static chamber or wind tunnel shall not exceed 2 km/hr.

(2) *Aerosol generation equipment.* For purposes of these tests, the test aerosol shall be produced from commercially available, bulk Arizona road dust. To provide direct interlaboratory comparability of sampler loading characteristics, the bulk dust is specified as 0-10 μm ATD available from Powder Technology Incorporated (Burnsville,

MN). A fluidized bed aerosol generator, Wright dust feeder, or sonic nozzle shall be used to efficiently deagglomerate the bulk test dust and transform it into an aerosol cloud. Other dust generators may be used contingent upon prior approval by the Agency.

(3) *Isokinetic sampler.* Mean aerosol concentration within the static chamber or wind tunnel shall be established using a single isokinetic sampler containing a preweighed high-efficiency total filter.

(4) *Analytic balance.* An analytical balance shall be used to determine the weight of the total filter in the isokinetic sampler. The precision and accuracy of this device shall be such that the relative measurement error is less than 5.0 percent for the difference between the initial and final weight of the total filter. The identical analytic balance shall be used to perform both initial and final weighing of the total filter.

(d) *Test procedure.* (1) Calculate and record the target time weighted concentration of Arizona road dust which is equivalent to exposing the sampler to an environment of $150 \mu\text{g}/\text{m}^3$ over the time between cleaning specified by the candidate sampler's operations manual as:

EQUATION 40

$$\text{Target TWC} = 150 \mu\text{g}/\text{m}^3 \times t$$

where:

t = the number of hours specified by the candidate method prior to periodic cleaning.

(2) Clean the candidate sampler. (i) Clean and dry the internal surfaces of the candidate sampler.

(ii) Prepare the internal surfaces in strict accordance with the operating manual referred to in section 7.4.18 of 40 CFR part 50, appendix L.

(3) Determine the preweight of the filter that shall be used in the isokinetic sampler. Record this value as InitWt.

(4) Install the candidate sampler's inlet and the isokinetic sampler within the test chamber or wind tunnel.

(5) Generate a dust cloud. (i) Generate a dust cloud composed of Arizona test dust.

(ii) Introduce the dust cloud into the chamber.

(iii) Allow sufficient time for the particle concentration to become steady within the chamber.

(6) Sample aerosol with a total filter and the candidate sampler. (i) Sample the aerosol for a time sufficient to produce an equivalent TWC equal to that of the target TWC ± 15 percent.

(ii) Record the sampling time as t .

(7) Determine the time weighted concentration. (i) Determine the postweight of the isokinetic sampler's total filter.

(ii) Record this value as FinalWt.

(iii) Calculate and record the TWC as:

EQUATION 41

$$TWC = \frac{(FinalWt - InitWt) \times t}{Q}$$

where:

Q = the flow rate of the candidate method.

(iv) If the value of TWC deviates from the target TWC ± 15 percent, then the loaded mass is unacceptable and the entire test procedure must be repeated.

(8) Determine the candidate sampler's effectiveness after loading. The candidate sampler's effectiveness as a function of particle aerodynamic diameter must then be evaluated by performing the test in § 53.62 (full wind tunnel test). A sampler which fits the category of inlet deviation in § 53.60(e)(1) may opt to perform the test in § 53.63 (inlet aspiration test) in lieu of the full wind tunnel test. A sampler which fits the category of fractionator deviation in § 53.60(e)(2) may opt to perform the test in § 53.64 (static fractionator test) in lieu of the full wind tunnel test.

(e) *Test results.* If the candidate sampler meets the acceptance criteria for the evaluation test performed in paragraph (d)(8) of this section, then the candidate sampler passes this test with the stipulation that the sampling train be cleaned as directed by and as frequently as that specified by the candidate sampler's operations manual.

§ 53.66 Test procedure: Volatility test.

(a) *Overview.* This test is designed to ensure that the candidate method's losses due to volatility when sampling

semi-volatile ambient aerosol will be comparable to that of a federal reference method sampler. This is accomplished by challenging the candidate sampler with a polydisperse, semi-volatile liquid aerosol in three distinct phases. During phase A of this test, the aerosol is elevated to a steady-state, test-specified mass concentration and the sample filters are conditioned and preweighed. In phase B, the challenge aerosol is simultaneously sampled by the candidate method sampler and a reference method sampler onto the preweighed filters for a specified time period. In phase C (the blow-off phase), aerosol and aerosol-vapor free air is sampled by the samplers for an additional time period to partially volatilize the aerosol on the filters. The candidate sampler passes the volatility test if the acceptance criteria presented in table F-1 of this subpart are met or exceeded.

(b) *Technical definitions.* (1) Residual mass (RM) is defined as the weight of the filter after the blow-off phase subtracted from the initial weight of the filter.

(2) Corrected residual mass (CRM) is defined as the residual mass of the filter from the candidate sampler multiplied by the ratio of the reference method flow rate to the candidate method flow rate.

(c) *Facilities and equipment required—*(1) *Environmental chamber.* Because the nature of a volatile aerosol is greatly dependent upon environmental conditions, all phases of this test shall be conducted at a temperature of 22.0 ± 0.5 °C and a relative humidity of 40 ± 3 percent. For this reason, it is strongly advised that all weighing and experimental apparatus be housed in an environmental chamber capable of this level of control.

(2) *Aerosol generator.* The aerosol generator shall be a pressure nebulizer operated at 20 to 30 psig (140 to 207 kPa) to produce a polydisperse, semi-volatile aerosol with a mass median diameter larger than 1 μm and smaller than 2.5 μm . The nebulized liquid shall be A.C.S. reagent grade glycerol ($\text{C}_3\text{H}_8\text{O}$, FW = 92.09, CAS 56–81–5) of 99.5 percent minimum purity. For the purpose of